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Australasian environmental economics: contributions, conflicts and 'cop-outs'*

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Australian and New Zealand environmental economists have played a significant role in the development of concepts and their application across three fields within their sub-discipline: non-market valuation, institutional economics and bioeconomic modelling. These contributions have been spurred on by debates within and outside the discipline. Much of the controversy has centred on the validity of valuations generated through the application of stated preference methods such as contingent valuation. Suggestions to overcome some shortcomings in the work of environmental economists include the commissioning of a sequence of non-market valuation studies to fill existing gaps to improve the potential for benefit transfer.

Key words: bioeconomic modelling, institutional economics, non-market valuation.

1. Context

The emergence of environmental economics in Australia and New Zealand has reflected growing public interest in and heightened political debate over environmental issues including the flooding of Lake Pedder in Tasmania, logging of old growth forests, salinisation of farmland and waterways and the restoration of environmental river flows.

To begin a consideration of Australasian environmental economics, two definitional matters require resolution: first, what is environmental economics as distinct from other areas of the economics discipline and second, what distinguishes Australian and New Zealand environmental economics from international developments?

Environmental economics can be defined very broadly. The approach taken in this paper is to consider environmental economics in a more restricted way by excluding developments in the economics of natural resources, apart from when the analysis involves trade-offs between the exploitation of natural resources and impacts on the ecosystem. For instance, the consideration of the optimal rate of extraction of a non-renewable resource of a mineral or the optimal rotation length of a plantation forest is considered in this paper to be outside the realm of environmental economics (and part of resource economics) until such considerations involve environmental externalities

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such as pollution due to mine tailings and biodiversity protection in old growth forests, respectively. Hence, what is looked for here is an impact – negative or positive – on the natural environment.

Australasian environmental economics has developed mostly from studies in agricultural and resource settings. For example, many of the so-called 'green' issues of Australasian environmental economics have centred on microeconomic trade-offs between extractive agricultural enterprises and the condition of the environment. Such trade-offs include water being allocated between irrigated agriculture and environmental flows in rivers and the clearing of remnant vegetation for pastures or crops as opposed to protecting it as a source of biodiversity. Similarly, 'brown' issues have focused on resource development concerns such as mine site rehabilitation and the environmental impacts of mineral processing.

This focus of Australian and New Zealand environmental economics on issues associated with agriculture and resources has seen the journal of this Society, the *Australian Journal of Agricultural and Resource Economics* (AJARE) – and before it, the *Australian Journal of Agricultural Economics* (AJAE) and the *Review of Marketing and Agricultural Economics* (RMAE) – assume the mantle as the prime repository for the Australasian environmental economics knowledge base.

It is within this context that this paper is set. The first goal is to provide a viewpoint on Australasian environmental economics by examining the contributions made, the conflicts that have emerged both within and outside the subdiscipline and the shortcomings or 'cop-outs' of the profession. This viewpoint draws on material published in the AJARE, AJAE and RMAE; however, it will be necessarily supplemented when discussing omissions and conflicts. The time frame of this review is the past 20 years; chosen primarily for personal reasons in that my first contribution to this literature was published in 1984. The second goal is to provide some thoughts on future issues that may face the Australian and New Zealand environmental economics profession.

2. Contributions

The major contributions of Australasian environmental economists can be considered in three categories: non-market valuation (NMV), institutional economics and bioeconomic modelling. Each of these contributions is detailed in the following subsections.

2.1 Non-market valuation

A key feature of environmental economics is the consideration of resource use choices that have impacts on environmental assets that are not bought and sold in markets. For economists to say much about such choices within the framework of neoclassical welfare economics, requires an ability to estimate non-market environmental benefits or costs involved in monetary terms. The challenge to provide such estimates accurately has been a primary focus of local and international environmental economics (Adamowicz 2004).

Two broad types of NMV techniques have been developed: those that rely on the preferences of people for environmental goods and services being revealed in related

markets and those that involve people stating their preferences in structured questionnaires. Australasian contributions in both categories have helped develop these techniques through innovative applications and explorations of their controversial aspects.

The revealed preference technique that has received attention in the Australasian context is the travel cost method (Beal 1995; Chotikapanich and Griffith 1998; Kennedy 1998; Common *et al*. 1999). Two stated preference techniques have been developed and debated: the contingent valuation (CV) method and choice modelling (CM). The validity of estimates derived from these techniques has been a major focus of the studies undertaken. Studies by Bennett (1984) and Sinden (1988) were supportive of the use of CV. Bennett and Carter (1993) were more circumspect in their conclusions following their analysis of CV data collected in the context of alternative management strategies for the forests of south-east Australia and Blamey *et al*. (1995) were critical of the technique. They argued that respondents to CV questions were likely to act as 'citizens' rather than 'consumers' and that this voided the use of CV-derived values in comparisons with market-derived values. Rolfe and Bennett (1996) disputed the distinction made between citizen and consumer viewpoints and a later study by Curtis and McConnell (2002) revisited the issue by presenting empirical evidence to dispute the Blamey *et al*. hypothesis.

The criticism of CV by Blamey *et al*. was part of an international questioning of the technique, largely brought on by the debate surrounding the use of CV to determine the compensation to be paid for damage caused to the environment following the Exxon Valdez oil spill. This debate was mirrored in Australia by arguments regarding the use of CV to estimate the costs of environmental damage expected from mining Coronation Hill, adjacent to Kakadu National Park.

The controversy spawned limited further development of the technique in Australasia, with two further studies being published in the Society's journals to date (Bennett *et al*. 1998; Kerr 2000). The debate was one impetus for the development of CM. Since 1999, the AJARE has featured a number of CM applications. Blamey *et al*. (1999) estimated the environmental costs associated with the expansion of Canberra's water supply. Several other studies in different settings followed (Blamey *et al*. 2000; Mallawaarachchi and Quiggin 2001; Rolfe *et al*. 2002; Morrison and Bennett 2004; Van Bueren and Bennett 2004).

A feature of these studies has been attempts to validate the estimates derived. For instance, Rolfe *et al*. (2002) looked for a priori expected framing effects in their results. Morrison and Bennett (2004) considered the strength of an econometric model explaining respondents' choices as validation. These efforts reflected the scepticism held by some members of the profession and policy-makers/advisors regarding stated preference results.

In overview, the contribution made to the NMV literature has been significant with more attention being paid to the development of stated preference techniques rather than revealed preference techniques. This balance of effort is different from the one evident in the broader international literature (Adamowicz 2004) where relatively more attention has been given to revealed preference techniques such as hedonic pricing and the production function approach. In addition, relatively more focus has been given

to CM in the Australasian literature compared with the international literature where CV has been more heavily applied. Between 1984 and 1993, four NMV papers were published in the AJAE compared to 15 papers in the past decade.

2.2 Institutional economics

The analysis of institutions that provide incentives for the provision of environmental goods and services has formed another focus for Australasian environmental economists. Recognising that many environmental issues arise because existing rules governing human behaviour do not provide incentives for the optimal allocation of resources, the profession has looked for alternatives. Traditional analyses of 'market failures' that give rise to suboptimal allocation of environmental resources have given way to the consideration of the reasons why markets have not formed for this type of resource and what measures may allow markets to form, or what alternative institutions may be installed to see Pareto improvements in allocations.

A key focus within this issue has been property rights with recurrent applications in the contexts of land degradation, notably dryland salinity and water. Quiggin (1986) drew attention to the distinction between common property and open access resources, arguing that by mistakenly equating the two institutional arrangements, policy-makers had ignored the prospects of using the vesting of rights over environmental assets to groups as an alternative to both atomistic ownership (private property rights) and no ownership (open access). Although Quiggin recognised the difficulties associated with the coordination of groups once the numbers increased, he did not examine the problems of information about individuals' preferences or the biophysical relationships between causes and effects. In the case of dryland salinity, this information is critical to the definition and defence of property rights, be they common property or private, because without it, property essentially becomes open access.

Wills (1987) examined this information problem noting the significance of transaction costs in addressing questions about resource use where impacts on environmental assets are apparent. As well as noting that resource use decisions should include the costs of securing the desired resource use outcomes, Wills specifically linked resource supply and use incentives facing individuals to the property rights regime installed. Wills (1992) returned to this theme by introducing the concept of institutional settings providing 'signals' to resource suppliers and users. The contributions made by both Quiggin and Wills were synthesised in Marshall *et al*.'s (1996) paper on integrated catchment management.

Further institutional developments in the context of water were made by Brennan and Scoccimarro (1999) and Crase *et al*. (2000). Both papers investigated the prospects of alternative property rights regimes for the allocation of water between extractive uses such as irrigated agriculture and environmental flows. Brennan and Scoccimarro advocated formalised rights for environmental flows so that 'in-stream' flows could be traded. Crase *et al*., however, were more sceptical about the prospects of trade to achieve environmental goals. They cited Quiggin's (1986) concerns regarding the apparent conflict between making water entitlements more secure to facilitate the efficient use of the water resource through trade and the uncertainty about what levels of

environmental flows will meet community demands. Some empirical evidence centring on the lack of permanent trades in water entitlements was used to justify their argument.

Quiggin (2001) revisited his earlier theme of advocating a common property approach to water resources in the Murray–Darling Basin by incorporating transaction costs into his analysis. Yet in the following year, Bell (2002) called for the introduction of trading houses for water entitlements for environmental flows, maintaining an alignment with a private property right approach.

Although the common property approach to water rights was being debated, Pannell (2001) and Pannell *et al*. (2001) raised the issue in the context of dryland salinity. They questioned the effectiveness of common property-based initiatives such as Landcare and integrated catchment management in achieving dryland salinity outcomes. Pannell (2001) argued that property rights-based solutions such as market-based instruments would be inefficient because the salinity reduction benefits they generate are likely to be less than the costs of the payments made by government. Instead he advocated a combination of a more geographically targeted public response, including engineering works, and the development of farm enterprises that would be both profitable and have positive dryland salinity outcomes. Also, Pannell *et al*. (2001) questioned the relevance of salinity as an externality in the Western Australian context noting that the actions of individual farmers often result in salinity consequences for themselves alone.

The conceptual institutional analysis changed focus with the publication of findings from the BushTender trial (Stoneham *et al*. 2003; Strappazzon *et al*. 2003). In this trial, the Victorian Government purchased rights to remnant vegetation stands on private property. A feature was the 'collectivisation' of the demand side for remnant vegetation. That is, landowners were asked to sell the protection of native vegetation on their lands (by accepting payment for protection works such as fencing to exclude stock) to the government who acted as a 'representative' of the public's demand for the environmental benefits offered by the protected native vegetation.

A further minor theme running through the institutional economics aspect of Australasian environmental economics considered the role of government as the buyer of environmental 'public goods'. Its earliest expression was in Kingwell (1994), where the potential for trading in Australian native species of birds was explored: the transaction costs associated with differentiating between wild birds and those bred in captivity (and hence the costs associated with defining the property right to the birds) could be reduced through the use of genetic labelling. This point was also pursued by Bennett (1995) who questioned the clarity of the distinction made between private and public goods when it came to the benefits of natural ecosystem protection. He argued that the prospects of private ownership or management of protected natural areas should be explored in cases where the public good aspects of nature protection can be supplied as joint products of privately supplied areas.

Clarke (2000) added a dimension by pointing out that the additional transaction costs associated with bird migrations across international boundaries reduces the prospects for private trade achieving species conservation.

The contribution made by Australasian environmental economists through the application of institutional economic principles has been evident in the development of

environment/natural resource policy over the past 20 years. The Landcare movement and integrated catchment management were reflections of the common property arguments put forward by the profession. The subsequent redirection of policy toward a private property rights-based approach, as evident in the development of water markets, initiatives such as the BushTender scheme and the growth in private sector nature conservation enterprises such as Australian Bush Heritage, can be seen as a response to the difficulties, including 'free-rider' problems, associated with the common property approach. They are also a response to a growing recognition of the incentive problems inherent in regulatory responses to resource use problems.

Anderson (2004) succinctly outlines the public and common property difficulties. His advocacy for a private property-based system of environmental resource allocation, however, fails to deal adequately with cases where transaction costs preclude the establishment of a market but where collective action has the potential to lower those costs.

The challenge remains to develop a policy response that combines the strengths of the regulatory, common property and private property approaches. The extent of the contribution made under the title of institutional economics has expanded over time. From 1984 to 1994, only three papers were published on the topic in AJAE. Subsequently, over a dozen papers have appeared.

2.3 Bioeconomic modelling

By seeking to explain and predict cause and effect relationships in ecosystems and then to investigate the economic consequences of those relationships, bioeconomic modelling seeks to tackle a component of the information problem described in the previous subsection. The contribution by Australasian environmental economists has varied from relatively straightforward considerations of the costs of alternative resource use strategies to complex integrations of biophysical models of ecological and farming systems with social cost–benefit analyses and policy advice. The common denominator of this aspect of environmental economics has been an attempt to link the environment to some aspect of economic performance.

The most basic form of bioeconomic modelling involves the estimation of opportunity costs arising from an environmental issue. Sinden and Jones (1985) considered the issue of eucalyptus dieback in the New England region, demonstrating that addressing the decline of the tree population would cause land owners financial costs not only through the direct financial costs of tree planting and protecting existing trees but also in reduced land productivity.

More sophisticated modelling was used by Alaouze and Fitzpatrick (1989) in their analysis of investment options to reduce salinity in the Murray–Darling Basin. Using mixed integer linear programming, they sought to identify the combination of salinity reducing investments that would achieve a specified goal while minimising the net present value of costs. Biophysical links were drawn between each investment and its impact on salinity. The economic modelling involved aggregate cost minimisation. They concluded that their approach offered significant advantages over standard cost–benefit analysis but overlooked salinity reduction benefits. Their bioeconomic model

presented was, therefore, more of a cost-effectiveness analysis designed to achieve a predetermined – and apparently arbitrarily defined – level of salinity reduction.

The omission of estimates relating to environmental impacts also occurs in Passmore and Browns' (1991) consideration of environmental consequences of rangeland management in Queensland. They used stochastic dynamic programming to analyse optimal stocking rates under varying conditions, demonstrating that graziers would risk the degradation that comes with higher stocking rates in response to higher wool prices, increased discount rates and lower property size. Greiner (1996) used a different perspective by analysing the costs caused to landowners by increasing levels of dryland salinity. Gretton and Salma (1997) note that on-farm consequences of land degradation are both positive and negative. That is, profitable enterprises can have negative on-farm repercussions. Yet Gretton and Salma recognised how the adaptive behaviour of farmers could alter some of these negative consequences.

All of these bioeconomic modelling studies focus on cost aspects of environmental change. They also account only for on-farm impacts. For instance, typically these studies consider the costs of an environmental change, say dryland salinity, in terms of reduced crop yields or additional drainage expenses but they ignore social costs such as the increased probability that an endangered species will become extinct due to habitat loss.

Mallawaarachchi and Quiggin (2001) made some way toward addressing these limitations. In their analysis of land use change in sugar regions along the Queensland coast, they integrated choice-modelling-derived estimates of the values of different types of remnant vegetation with farm profit estimates in a geographical information system to recommend socially preferable land use combinations. Hence, a cost–benefit framework was built into the bioeconomic modelling process, with environmental impacts being explicitly recognised through a CM module, and policy recommendations being an end product.

The flexibility of the bioeconomic modelling has been demonstrated by research conducted by Heaney *et al*. (2001) on water salinity, Cacho *et al*. (2001) on dryland salinity control and Cacho *et al*. (2003) on carbon sequestration opportunities. Cassells and Meister (2001) demonstrated the potential for using Computable General Equilibrium modelling in costing the New Zealand dairy industry's response to national water quality standards.

Some key points emerge regarding the contribution of bioeconomic modelling to environmental economics. First, it can be applied in a wide variety of contexts ranging from farm-level to national perspectives and from specific local environmental issues to global issues like climate change. Yet there remains a misconception that bioeconomic models can provide all the information necessary for a policy choice. Although it is true that some modelling studies offer a range of policy insights (e.g., Mallawaarachchi and Quiggin 2001) most only consider single aspects of policy choices. Many studies ignore non-market environmental benefits or costs. In a sense then, what these bioeconomic models offer are estimates of threshold financial values against which policy-makers can judge the extent of non-monetary values.

The growth in the contribution made under the heading of bioeconomic modelling has not been as sharp as with the other categories of environmental economics treated

in this paper. However, increases in the level of sophistication and the scope of analysis have featured.

3. Conflicts

Contributions of Australasian environmental economists have been wide-ranging and some have been at the forefront of both the development of thinking on these issues and their adaptation for use. The extent of the contributions is also increasing. Whereas in the 1980s the norm was for each volume of this journal to contain one environmental economics-based paper, in the 2000s it has been the case that a paper featuring environmental economics has appeared on average in each issue. On this basis it can be concluded that Australasian environmental economics is alive and well. But over the course of the past 20 years, numerous controversies have arisen.

At one level, these conflicts have presented threats to the advancement of the subdiscipline. But at another, they have provided the pressure for the subdiscipline to evolve faster and for its products to be more robust to intellectual challenge. The conflicts mostly have not been Australasian-specific but have been part of international debates.

There has been debate between those in the discipline who adhere to a neoclassical basis for their analyses and those who question the relevance of the assumptions that underpin the neoclassical framework when dealing with environmental issues. The latter have generally grouped under the banner of ecological economists. This is a definition of ecological economics that differs from that promulgated by Harrison and Tisdell (1994) who reserve the label for those undertaking studies defined here as bioeconomic modelling. Differences between the two 'schools of thought' centre on concerns of those adhering to the neoclassical framework about the 'breaches' made by ecological economists. For instance, some ecological economists object to the concept of trade-offs accepted by neoclassicists in instances when they have a prior objection perhaps on ethical grounds to a potential outcome.

Other concerns about the use of economics to consider environmental issues have arisen from outside the profession and have been the subject of some conflict. Examples of the concerns and the refutations by members of the profession include: Cutbush (1995), 'mandatory recycling is good for the environment'; Brunton (1995), 'we must adopt a risk averse approach and always err on the side of caution when dealing with environmental issues'; and Rolfe (1995b), 'the ethical imperative of intergenerational equity requires us to place ecological considerations, such as the conservation of biological diversity, ahead of other matters'.

In the remainder of this section, some of the specifically Australian conflicts are detailed under the same three subheadings used to document the contributions.

3.1 Non-market valuation

The conflicts surrounding the development of NMV techniques have been to the fore of environmental economics in Australia and New Zealand for the past 20 years. First, there has been an ongoing debate within the profession as to the validity of

estimates arising from both revealed preference and stated preference techniques. Second, questions regarding the use of NMV techniques have been raised from lobbyists, policy-advisors and policy-makers who are non-economists.

The debate in the AJAE regarding responses to CV questionnaires between Blamey *et al*. (1995) and Rolfe and Bennett (1996) was one dimension of a much larger debate. The Blamey *et al*. criticism related to a fundamental issue of whether or not responses were consistent with neoclassical principles underpinning welfare economics. This line of argument provided a positivist dimension to views advanced by lobby groups that placing monetary values on environmental impacts was inappropriate.

Other positivist concerns were focused more on the accuracy of the estimates. The extent of bias arising from the hypothetical nature of questions and the potential for strategic bias were at the forefront and gave rise to the hypotheses tested by Sinden (1988). The conflict over a CV study for the Coronation Hill mining inquiry was perhaps the climax of this debate (see Bennett 1996).

The criticism of CV gave heightened impetus to the development of CM as an alternative stated preference technique with superior bias prevention properties. However, the CV validity debate has enveloped CM and affected environmental policy-making.

The controversial nature of stated preference techniques has been one cause for policy-advisers to be cautious in commissioning such studies as inputs into the development of policies with environmental impacts. In addition, being able to question the usefulness or validity of adding environmental value estimates to a cost–benefit analysis provides decision-makers and lobbyists with more degrees of freedom to pursue rents in the decision-making process. Without environmental value estimates, thresholds provided by market-based economic assessments must be compared subjectively to assessments of non-market values.

This has opened the door to decision-making frameworks other than cost–benefit analysis. Alaouze and Fitzpatrick (1989), for example, advocate a mathematical programing-based cost-effectiveness analysis. Another contender is multicriteria analysis (MCA). Because MCA requires resource use impacts to be estimated in a diversity of metrics, it avoids the cost–benefit analysis requirement of environmental, non-market impacts to be estimated in monetary terms. The problem with this approach, however, is that at some stage the trade-off between the various impacts is required. Usually, 'weights' are applied to the individual impacts before they are subjected to the aggregation process. These weights are an expression of preferences across impacts. In MCA, the most common way for these weights to be determined is subjectively by either the analyst or the decision-maker, and that can open the process to rent-seeking behaviour.

The debate regarding the validity of non-market value estimates has not been restricted to stated preference techniques. One of the most widely used revealed preference techniques, the travel cost method, was also the subject of conflict. The debate was on two levels: the capacity of the technique to deliver estimates that are conceptually valid (Common *et al*. 1999) and technical issues regarding application (Chotikapanich and Griffiths 1998). This debate appears to have made less of an impact on policy-making than the stated preference conflict.

3.2 Institutional economics

The debate dominating the institutional economics arena of environmental economics has centred on the policy prospects offered by various rights regimes: private property, common property and government regulation. The decade of Landcare can be viewed as an expression of the view that the common property model is the most appropriate regime for the management of environmental assets that involve individual non-excludability but for which jointness of supply does not apply. The point made is that the transaction costs of excluding individual users if ownership is vested in an individual (i.e., private property) are greater than the transaction costs associated with monitoring group use under a common property rights regime. In other words, the group, through relatively cheap anti-free-riding strategies, can secure exclusion. Similarly, integrated catchment management relies on incentives introduced from within the group charged with responsibility for the catchment.

Community-based management of environmental resources received substantial government support particularly through payments made under the Natural Heritage Trust fund. The effectiveness of this regime was questioned for (at least) two reasons. First, the funds were spread so thinly across the nation's environmental problems that tangible benefits were difficult to find. Second, difficulties were experienced in maintaining community interest in achieving project goals. Even with government funding, individuals were still required to make private inputs. The incentive to make these private investments to secure community-wide gains waned when only a small subgroup of volunteers consistently made the private contributions. Free-riding behaviour was not helped by government initiatives to employ Landcare coordinators. Because these people were being paid by the government to undertake what had been voluntary activities, the incentive to volunteer was further reduced.

At the same time as these difficulties were being faced under common property management regimes, new initiatives were being taken to promote private property-based regimes. Market-based instruments were advanced as providing stronger incentives for environmental goal achievement. Water provides a good example, with the separation of water entitlements from land title. Setting caps on extractions and hence the fixing of 'environmental flows' has been the process to meet environmental demands.

Two points are salient. First, there is dispute over the use of the private property regime for the allocation of water extractions. Although those in favour argue that the security of well-defined rights is critical to the efficiency of the industries dependent on the water (Freebairn 2005), those against suggest that the uncertainty of the level of demand for environmental uses is such that rights should be held in common with allocations between differing demands from within the community being adjusted given prevailing demand conditions (Tan 2005).

Second, the current situation involves some water rights being held effectively by the state through its setting of caps and environmental flow levels. In some states these flow levels have been set in consultation with the community and may be thought of as de facto common property. In others, the process of determination is more 'top-down'. Nowhere are these rights traded, although the Murray Valley Wetlands Working Group has used Natural Heritage Trust funds to buy temporary water entitlements to

extend a flooding event in the Murray River. Bell (2002) outlined a similar approach in examining the prospects of a trading house for water entitlements and Bennett (2005) looked at the prospects for private sector conservation enterprises to take a role in purchasing rights for environmental flows.

3.3 Bioeconomic modelling

Of the three segments of environmental economics considered here, bioeconomic modelling has been the least controversial, perhaps because of its strong positivist focus. What contention there has been arose at the policy end of the bioeconomic process. In some ways, this has been mixed in with the controversy regarding NMV. For bioeconomic modelling to present policy-makers with a complete picture of biophysical cause and effect relationships (of the 'what if' type scenarios) and the value these outcomes hold for society, environmental impacts and their non-market values need to be integrated.

Another technique that may be regarded as a means of estimating the impacts of environmental resource use decisions is input–output analysis. Analysts can use this technique to impose a 'shock' on an economy – usually at the regional level – and estimate the resultant changes in expenditure patterns, including employment impacts. For instance, the impacts on a regional economy resulting from changes to legislation regarding the clearing of vegetation could be assessed using input–output analysis. This process is a legitimate way to assess structural impacts of resource use changes and is helpful to policy-makers developing measures to cope with such structural changes, including infrastructure provision. However, it should not be mistaken as a tool for the assessment of net impacts on social well-being. It is not based on concepts of producer and consumer surplus and so conclusions of the type to be drawn from cost–benefit analysis cannot be made from input–output analyses.

4. Cop-outs

Some areas of environmental economics have either been neglected or ignored. This is both good and bad news: good in that there are still fields available for active and productive research, but bad in that policy advice to date has been inadequate and the unchallenged areas may have limited research progress in other fields. Shortcomings can be found in all three fields considered in the following subsections.

4.1 Non-market valuation

Although Australasian environmental economists have developed and applied NMV techniques, nonetheless the integration of NMV into policy-making in both Australia and New Zealand is still lacking. This short-fall has been due particularly to the relatively high costs of undertaking stated preference techniques and perceptions of the inaccuracies embedded in the techniques' results. Opportunities for rent-seeking behaviour in policy formation and implementation can arise. Without an appreciation of the strength of the community's values for environmental benefits and costs, favour

may be given to outcomes with readily estimated values. These will predominantly be outcomes that yield marketed, extractive values. Alternatively, if policy-makers are left to 'judge' the strength of environmental preferences, green lobby groups can mobilise their political forces to sway the decision toward environmentally favourable outcomes. In both cases, predicting which way a decision will go relates more to political economy than resource use efficiency.

The perceived high cost of NMV has had several consequences. Where decision-makers have been pressed to take into account non-market values, they have tended toward the use of market-based methods that are inconsistent with principles of welfare economics. For instance, the costs associated with the draining and development of a wetland may be estimated using the replacement cost method that involves the calculation of the costs associated with the construction of an artificial wetland. This method, although convenient to apply, is problematic because the artificial wetland may not be a complete substitute for the original. Furthermore, the cost of the replacement has no conceptual link to the net benefit enjoyed from the original wetland.

A similar argument applies to the preventative expenditure method of environmental valuation that requires the estimation of costs associated with stopping the costs of environmental damage from occurring. Applying either of these techniques has the potential to deliver erroneous policy advice, an ironic consequence of attempts to avoid errors arising from the use of stated preference techniques.

Another concern has been the increased application of the benefit transfer process. Benefit transfer involves values previously estimated in some case study (the source) being used (transferred) to another setting (the target). Although this practice reduces the costs of value estimation, it is limited. First, the circumstances present in the source study have to resemble those present in the target. Second, the source study should be a sound application of a valid technique. Both of these limitations require that there is a database of robust NMV studies, covering a wide range of conditions, to act as sources. It is, therefore, problematic in Australia and New Zealand for benefit transfer to be widely applied because of the paucity of source studies. Although the NSW Environment Protection Authority maintains the ENVALUE database, the number of studies it contains with results that are reliable and relevant to Australasian conditions is limited. So, policy-makers using the benefit transfer process are free-riding on the publicly-available information on NMV. Without more agencies supporting new applications, the problems associated with using benefit transfer will remain.

An additional factor that provides a barrier to the further development of NMV techniques is the limitations of the biophysical science that is a prerequisite for their application. For instance, in stated preference technique applications, respondents are informed of the consequences of some particular resource management option and their willingness to pay (or accept) is interrogated. In designing such questionnaires, economists require the assistance of their biophysical science colleagues to predict the consequences in terms of factors or attributes that are relevant to people. Frequently, research on cause and effect relationships is unrelated to people-relevant attributes. For instance, scientists may be able to predict biological oxygen demand changes in water caused by reduced nitrogen concentrations but they may be unable to predict fish

populations under different regimes of cattle grazing along stream banks. It is probably the latter impact that people are interested in. Hence, for stated preference techniques to advance, biophysical science research has to be more orientated to policy questions and people-relevant outcomes.

Other cop-outs revolve around more technical aspects of implementing NMV techniques. Risk and uncertainty are important features of most environmental management decisions but valuation studies have yet to attempt their incorporation. For instance, people indicate their concerns that resource management decisions have adverse impacts on endangered species. CM studies on that topic to date have used attributes such as 'the number of endangered species'. Yet the issue is more correctly described in probability terms. Some health economics applications of stated preference techniques address probabilistic outcomes but the same is yet to apply in 'green' environmental issues.

The dynamics of environmental values are also not well understood. Conjecture has it that society has shifted its preferences toward environmental outcomes over time but no valuation studies have been performed to test this hypothesis. Valuation studies are important in this respect because they have the advantage of forcing individuals to face trade-offs that characterise choices and hence involve the revelation of preferences against the benchmark of other available options.

Important groups within Australian and New Zealand communities have been neglected in terms of having the strength of their environmental preferences estimated. Only one study has considered the aboriginal community's environmental values (Rolfe and Windle 2003) and no studies have investigated Maori preferences. Particular challenges face such applications, particularly when such communities are not fully engaged in the market economy.

There are also notable cop-outs among the revealed preference techniques. For instance, no hedonic pricing studies for environmental goods and services have been reported in the Society's journals over the past two decades. Similarly, the production function technique for inferring the values of ecosystem services as inputs into the production of marketed commodities has not been applied. These techniques do not suffer the burden of truthful response validation faced by stated preference techniques because they use data observed from markets. Yet they remain neglected for a number of reasons.

First, the hedonic pricing technique requires large amounts of market data to enable the estimation of the relationship between price and an environmental attribute and the subsequent correlation between prices and the socioeconomic characteristics of buyers. Furthermore, to develop sufficiently strong econometric models of these relationships, trading in the markets must be relatively thick. In many cases in Australia, trading is too thin in markets where environmental attributes are relevant. Second, the range of values that the hedonic pricing technique can estimate is limited. There must be a related market to investigate and this implies that only use values will be available. In the case of the production function technique, it is generally a lack of biophysical data that limits its application. Before values can be estimated for ecosystem services as the shadow prices of inputs into a production process, the relationship between inputs and outputs needs to be defined. Biophysical scientists are yet to provide sound

quantification of relationships such as those between general soil microbes and agricultural production.

4.2 Institutional economics

Recent initiatives to develop market-based instruments for environmental management have caused a dramatic increase in research resources being devoted to the analysis of practical issues with institutional concerns at their heart. In particular, the use of experimental economics has featured in the analysis of the consequences of alternative institutional settings.

One element that has been neglected in this field is the empirical assessment of transaction costs under alternative institutional settings. Much has been made of the cost-effectiveness advantages of market-based instruments, yet little is known about the extent of transaction costs and their distribution between affected parties under the market-based approach compared to the regulatory 'command and control' approach. The important factor to recognise is that alternative institutional systems all have transaction costs, albeit of different types and different scales, as well as different incentive structures. It is erroneous to choose between alternative institutional structures on the basis of their net social benefits without including transaction costs. The distributional issue is interesting in the contemplation of this oversight. For instance, by moving from a regulatory approach to a market-based instrument approach, governments release a degree of control over the environment. Instead of dictating which supplier provides environmental services and how much, the government may only set the overall level of services required. This has cost-efficiency advantages but it also changes the transaction cost burden. Individual suppliers take on the task of determining the optimal mix of suppliers by operating in a new market. This involves them incurring the transaction costs associated with developing the required knowledge to work in that market. The costs formerly born by the government in determining the mix of suppliers are transferred.

A further omission from the institutional economics field is the integration of the demand for environmental goods and services into resource allocation mechanisms. The default position remains a reliance on the state to estimate the extent of demand and to mobilise resources from consolidated revenue to see that demand realised.

Demand-revealing institutional structures remain elusive for environmental goods and services with strong public-good characteristics. Even in the absence of such institutional arrangements, the focus on supply-side efficiency through market-based instruments has meant that non-market values have not been used to estimate the amounts of public funds to be devoted to purchasing 'environmental rights'. Rather 'ecological indices' have been used, as in the case of the BushTender scheme, to indicate what features are valuable to society. The potential is for such indices to reflect what is valuable to the ecologists who devise them rather than the broader public.

4.3 Bioeconomic modelling

The inadequacies in bioeconomic modelling have largely concerned the scope of the analyses. Early examples related ecological conditions to costs imposed on society.

Progress has seen increasing complexity of the costing models used. The tendency has been for researchers to use their cost-based work to draw policy conclusions or at least make statements regarding the incentives facing the parties.

The omission is in considering the benefit side of the issue. Two reasons are apparent. First, the science linking alternative management actions with environmental outcome attributes that are valued by society has been lacking. Second, the valuation of these outcomes has been problematic.

Without addressing these omissions, the potential for bioeconomic modelling is restricted from a policy perspective. Similarly, its prospects will be restricted if it moves to a framework of integrating benefits and costs that fails to adhere to the basic principles of welfare economics. The implication is that mechanisms such as MCA, that are not soundly founded, should not be taken as a 'short-cut' to policy relevance. Unless benefit–cost principles are integrated into bioeconomic modelling, researchers should be circumspect in their policy recommendations.

5. Conclusions

Much has been achieved in Australasian environmental economics over the past two decades. Much is yet to be done. NMV remains a point of conflict both within and outside the profession and an area of neglect. Perhaps because of its controversial nature, few economists want to risk basing their professional careers in this field. There are few people well-trained to do advanced research in NMV in Australasia.

For NMV to reach a point where environmental managers and policy-makers have confidence in its results, more studies will need to be performed. The evolutionary process required to see this development requires more experimentation. This will require growth in both the willingness of agencies – policy, management and research – to fund studies and the capacity of research bodies inside and outside government to do those studies.

A growth in capacity could be achieved simultaneously with greater experimentation through the funding of projects including training components and with longer time lines than those usually associated with the development of policy inputs. If these projects were selected to fill voids identified in databases such as ENVALUE, then they would also provide contributions to the stock of studies suitable for use in benefit transfer exercises. Specific technical issues including the integration of risk and uncertainty should be addressed in these applications. Replication of studies performed in the past would provide indications of changing environmental preferences. Extensions to involve aboriginal people would also add to the richness and relevance of the data on environmental preferences for policy-making.

Although stated preference NMV techniques have received most of the attention of critics, and hence may be regarded as being in most need for evolutionary development, the neglect of revealed preference techniques should also be addressed. In particular, the hedonic pricing and production function methods deserve greater attention.

More relevant biophysical science is a prerequisite for improved NMV (especially stated preference techniques and the production function method) and bioeconomic modelling. For this situation to improve there needs to be a better recognition on

the part of those funding policy relevant research that bridges have to be constructed between the disciplines and that both biophysical science and economics research require time.

The current developments in institutional design and application, including the use of experimental economics techniques, will go far in addressing the shortcomings in that field. Inclusion of the analysis of transaction costs will be important to ensure completeness in developing policy advice. Given that transaction costs have been found to account for more than half of all the costs of producing and distributing the national product in modern market economies (North 1990), their omission from the development of extensions to the market to encompass environmental resources could be serious.

In integrating the inputs of different aspects of environmental economics, the temptation for researchers and policy-advisers is to avoid elements of a complete analysis that are costly or controversial. Avoidance strategies such as MCA and input–output analysis involve departures from the rigour of welfare economics. The consequence is that the problems avoided by short-cut analysis result in different and often more intractable problems. For instance, using MCA requires the estimation of 'weights' for all the criteria, both market and non-market. The alternative faces the same problems of NMV techniques whether the weights are estimated through recourse to 'experts' or by means of a 'citizens' jury' approach. But the use of these alternatives brings additional issues such as rent-seeking behaviour. Put simply, the shortcuts are more problematic than the full analysis but many of their problems are not as well or as widely understood as those facing the full analysis.

The progress made in tackling environmental economics over the past 20 years has been displayed in the journals of this Society. However, the effectiveness of the Australian and New Zealand profession in providing leadership in environmental economics across the Asia Pacific region has been limited in comparison to that achieved by Australasian agricultural economists. That may well be a function of the stage of development of our regional neighbours. However, as economic development progresses, attention will turn increasingly toward environmental management issues. A leadership role for Australian and New Zealand environmental economists is apparent and could potentially be fostered by this Society.

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